Feed Stock Specifications

HYDROCARBONS

Propane, Propylene, or Ethylene ..... Min. 99.0 Mol. %
Water Content ..... Max. 50 ppm
Contained Sulfur ..... Max. 2 ppm

CHLORINATED HYDROCARBONS

Partially-chlorinated C_1, C_2, and C_3 Hydrocarbons .... Min. 99.0 Wt. %
Water Content ..... Max.100 ppm
Total Oxygenated Compounds ..... Max. 2500 ppm
Appearance ..... Water White

LIQUID CHLORINE ... Min. 99.7 Wt. % Cl_2
Oxygen ..... 500 ppm Max.
Water ..... 25 ppm Max.

Typical Feed Chemicals Consumption and By-Product HCl Production

TYPICAL HYDROCARBON FEED	T/T Product CCl_4	C_2Cl_4
Propane	0.11	0.19
Chlorine	1.65	2.10
By-Product HCl	0.71	1.25
TYPICAL CHLORINATED HYDROCARBON FEED		
Ethylene Dichloride	0.36	0.64
Chlorine	1.23	1.36
By-Product HCl	0.54	0.95

Raw materials requirement may vary widely with type of feed, product mixture and by-product alternatives.

Utilities Requirements

	Per Ton Product
Steam	1.2 tons
Electricity	73 KWHr
Cooling Water	140 m^3 circulated 10°C rise

Operating Labor, Maintenance, Laboratory and Supplies

Two operators required per shift plus supervisor shared with other operations.

Annual maintenance costs are about 6% of battery limits investment.

Operating supplies in 1978 were about $1.36 per ton product.

Laboratory costs as of 1978 were about $1.10 per ton product.

Product Applications

CARBON TETRACHLORIDE

Carbon tetrachloride is used almost exclusively for the manufacture of fluorocarbon refrigerants F-11 and F-12. Its non-flammable properties also make it useful as a blending material in preparation of grain fumigants, and flammability retarder for specialized solvents. It is also used as an extractant for oils, waxes, and fats. These uses are limited by its toxicity. Current U.S. regulations limit the mean concentration of carbon tetrachloride to 10 ppm in air for eight hours of exposure. (Time Weighted Average)

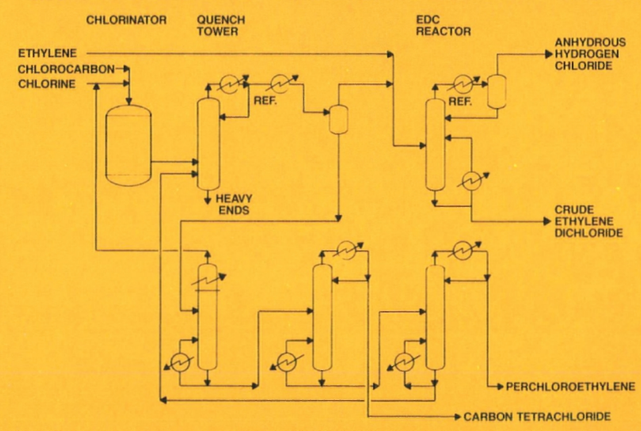
PERCHLOROETHYLENE

Perchloroethylene is the principal dry cleaning fluid in use today. Its excellent solvent action, non-flammability, stability, mild toxicity, lack of residual odor and ease of recovery, have been particularly adaptable to the dry cleaning industry. These same properties are finding increasing application in the vapor degreasing of metals where it is replacing trichloroethylene. Perchloroethylene is also used in the manufacture of fluorocarbon refrigerants F-113 and F-114. Current U.S. regulations limit the mean concentration of perchloroethylene in work areas to 100 ppm in air for eight hours of exposure. (Time Weighted Average)

Approximate Distribution of Uses in the U.S.A.

PERCHLOROETHYLENE	
Dry Cleaning Solvent	50%
Metal Cleaning	20%
Fluorocarbon Manufacture	17%
Textile Processing	6%
Other	7%
CARBON TETRACHLORIDE	
Fluorocarbon Manufacture	90%
Fumigants, Solvents, Extractants	10%

VULCAN PERCHLOROETHYLENE AND CARBON TETRACHLORIDE PROCESS



Vulcan Materials Company

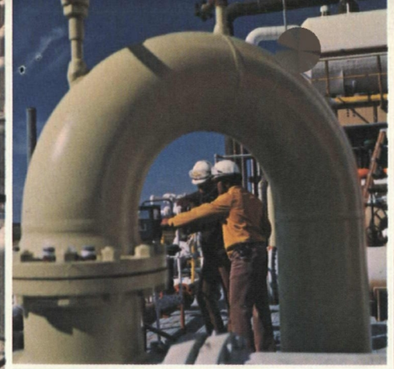
CHEMICALS DIVISION:
P.O. BOX 12283 / WICHITA, KANSAS 67277
Telephone: (316) 524-4211
Telex No. 417-432
Corporate Office: P.O. Box 7497 / Birmingham, Alabama 35223

Perchloroethylene and Carbon Tetrachloride

1

Vulcan Materials Company

Chemicals Division



Principle

Hydrocarbon and partially-chlorinated hydrocarbon feedstocks are thermally chlorinated to a mixture of perchloroethylene and carbon tetrachloride. All hydrogen in the feedstock molecule is converted to by-product HCl.

Typical Chemical Reactions

$C_3H_8 + 8\ Cl_2 > CCl_4 + C_2Cl_4 + 8\ HCl$

$3C_2H_4Cl_2 + 11\ Cl_2 > 2CCl_4 + 2C_2Cl_4 + 12HCl$

$C_3H_5Cl_3 + 5Cl_2 > CCl_4 + C_2Cl_4 + 5HCl$

Process Description

The process includes:

1. Thermal chlorination
2. Product purification
3. Recovery of the by-product HCl as anhydrous HCl or muriatic acid

The prepared feeds are chlorinated at elevated temperatures in a single-stage reactor. An excess of chlorine is used. The products are separated from by-product HCl and unreacted chlorine by condensation against cooling water and refrigeration. The resulting crude products are then purified by distillation without any wet neutralization steps.

The by-product HCl containing the excess chlorine may be absorbed in water to form muriatic acid, in which case the excess chlorine passes through the absorber, is dried, and recirculated to the chlorinator. If anhydrous HCl is desired, the chlorine in the HCl is reacted with ethylene to form ethylene dichloride. The HCl then passes out of the process as an anhydrous product after a condensation step which recovers the ethylene dichloride. The ethylene dichloride may be recycled to the thermal chlorinator.

Feed Chemicals

The Vulcan process uses almost any combination of C_2 and C_3 hydrocarbons and partially-chlorinated hydrocarbons. Up to about 1% of C-4's can be tolerated in the feed. Oxygen containing chloro-compounds must be limited to maximum of 2500 ppm. Typical feedstocks include ethylene, propane, propylene, propylene dichloride, ethylene dichloride, trichloroethane, chloro-process is its ability to economically convert waste chlorocarbons from vinyl chloride, propylene oxide, and other organic chlorination plants to useful products.

Product Distribution

This is an equilibrium reaction with the product distribution between C_2Cl_4 and CCl_4 being normally about equal. The equilibrium can be shifted in favor of one or the other by changing processing conditions. The product mix can be varied from the normal split of about 50% to a maximum of 90% of one product over the other, depending on the hydrocarbon-chlorocarbon feed used. Some are more susceptible to control of product mix than others.